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# NASA TECH BRIEF

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## Electropneumatic Rheostat Regulates High Current

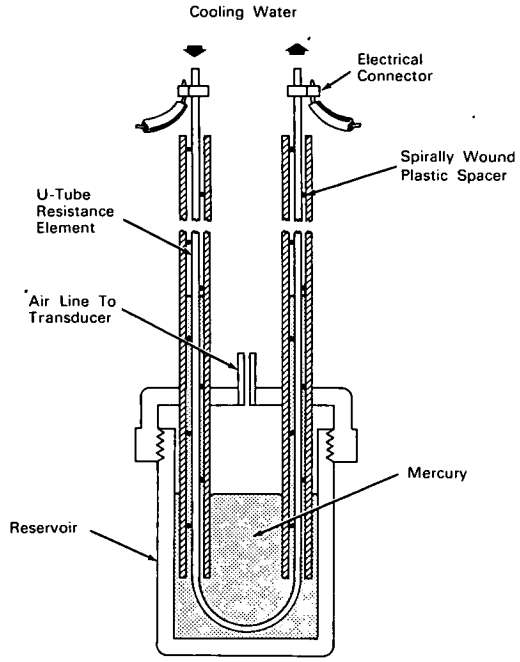


FIG. 1

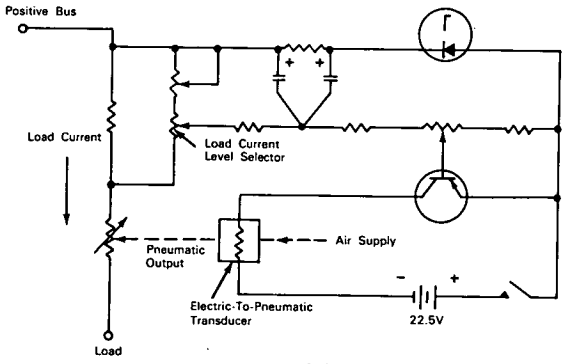


FIG. 2

**The problem:** To maintain a constant direct current in each of several high-power (megawatt range) parallel loads, of characteristically variable resistance, across a single source. It was desirable to use a single available dc generator to avoid purchasing separate power supplies, rectifiers, or rotary machines.

**The solution:** A simple, automatically-controlled rheostat system that will provide current regulation at any preset value by dissipating the proper amount of energy thermally. The electropneumatic rheostat uses a column of mercury to vary the effective length of a resistance element.

**How it's done:** The resistance element of the rheostat is a U-shaped stainless steel tube, internally cooled, immersed in a mercury reservoir, each leg being centered within a standpipe of low electrical resistance by a spiral insulating spacer. Air pressure from an electric/pneumatic transducer forces the mercury in the reservoir to rise into the area between the standpipes and the resistance element. Because the resistance element is short circuited to the standpipes at the surface level of the mercury, the current bypasses that portion of the element below the surface level and flows through the low-resistance standpipes. The resistance of the rheostat is, therefore, inversely

(continued overleaf)

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proportional to the applied air pressure. The control circuit senses changes in the load current and activates a commercially available electric/pneumatic transducer to convert a 0 to 5 milliamp dc signal to a 15 to 0 psi (inverse acting) pneumatic output that allows linear control of the rheostat. The load current level selector, a small potentiometer in the control circuit, serves as voltage divider in parallel with the load current shunt and permits manual changes in the control value of the load current. A plastic tube between the rheostat and transducer pneumatic output provides electrical isolation of the rheostat from the control circuit.

**Notes:**

1. This control system has been used to maintain constant current in each of five parallel dc circuits containing five electric arc loads, all supplied from a single dc source. A different current level could be set in each of the circuits. Because the loads are dc-arc discharges, which characteristically exhibit fluctuations in the load current, the control circuit is provided with ac filters that render the system insensitive to load fluctuations down to 10 cps with amplitude equal to the dc amplitude.
2. For this particular application, the rheostat units have a maximum resistance of about 0.8 ohm and are rated at 200 amperes for 1,000 psi cooling water.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California, 94035
   Reference: B65-10299

**Patent status:** NASA encourages commercial use of this innovation. No patent action is contemplated by NASA.

Source: Cleo B. Wagoner, Jack F. Håacker, and James R. Jedlicka
(ARC-44)